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THIS NOTICE INFORMS RECIPIENTS THAT THE DOCUMENT IDENTIFIED BY THE NUMBER (AND REVISION LETTER) SHOWN IN BLOCK 4 HAS BEEN CHANGED. THE PAGES CHANGED BY THIS SCN BEING THOSE FURNISHED HEREWITH AND CARRYING THE SAME DATE AS THIS SCN. THE PAGES OF THE PAGE NUMBERS AND DATES LISTED BELOW IN THE SUMMARY OF CHANGED PAGES COMBINED WITH NON–LISTED PAGES OF THE ORIGINAL ISSUE OF THE REVISION SHOWN IN BLOCK 4 CONSTITUTE THE CURRENT VERSION OF THIS SPECIFICATION.

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| | Revision and History | x | | |
| | Appendix D | | | |
| | D–i through D–14 | x | | |
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16. Technical Concurrence

_____ _____

Date

* "S" indicates supersedes earlier page. "A" indicates added page.

Form Date: 8/12/94

# International Ground System Specification Document

# International Space Station Program

**APRIL 26, 1996**
**Incorporates SSCN 000315**

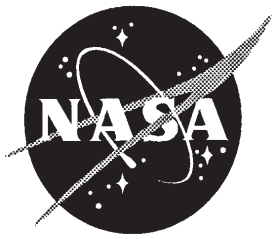

Russian Space Agency


Canadian Space Agency

Agence spatiale canadienne

agenzia spaziale italiana
(Italian Space Agency)


**National Aeronautics and Space Administration**
**International Space Station Program**
**Johnson Space Center**
**Houston, Texas**



## REVISION AND HISTORY PAGE

| REV. | DESCRIPTION | PUB. DATE |
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# APPENDIX D
# SEGMENT SPECIFICATION FOR THE JAPANESE EXPERIMENT MODULE GROUND SYSTEM REQUIREMENTS

## TABLE OF CONTENTS

## TABLE OF CONTENTS (continued)



## TABLES



## FIGURES

## D1. SCOPE

This specification establishes the performance and design requirements for the Japanese Experiment Module (JEM). This specification has been developed using SSP 41171, Preparation of Program Unique Specifications (a tailored version of MIL–STD–490), as a guide for type A system segment specification. Sections 1 and 3.1 are for informational purposes only and are not binding between National Aeronautics and Space Administration (NASA) and the National Space Development Agency of Japan (NASDA). Documents listed in section 2 are applicable to NASDA only to the extent that they are referenced in section 3.

The paragraph headers in 3.2.1 are based on the functional decomposition allocations to the JEM in the Space Station System specification, SSP 41000. The requirements in section 3.2.1 define the performance of the JEM. Requirements in sections 3.2.2 through 3.6 are constraints with which the JEM must comply. The performance requirements herein are applicable during nominal operations only and do not account for maintenance or contingency events unless otherwise addressed.

### D1.1 Identification.

Not applicable.

### D1.2 System overview.

The JEM is a facility developed by NASDA for the purpose of supporting research and development experiments in a microgravity environment in earth orbit as a segment of the Space Station. The JEM supports internally and externally mounted user payloads, provides pressurized and unpressurized logistics support, and remote manipulation of external items.

## D2. APPLICABLE DOCUMENTS

Paragraphs which reference documents identified with asterisks below are not applicable until NASDA review and concurrence.

### D2.1 Government documents.

#### D2.1.1 Specifications, standards, and handbooks.

The following specifications, standards, and handbooks of the exact issue shown form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

| | |
|---|---|
| SSP 41171<br>Rev. A<br>(May 19, 1995) | International Space Station Alpha Program<br>Preparation of Program – Unique Specifications.<br>(Reference paragraph 1.) |
| *SSP 45012<br>Rev TBD | CCC to NASDA Ground Segment ICD<br>(Reference paragraphs D3.1.5.1.1, D3.2.1.1.1.2.1, D3.2.1.1.1.2.2, D3.2.1.2.2.1.2, D3.2.1.2.2.1.3) |
| *SSP 45025<br>Rev TBD | HOSC to NASDA Gateway ICD<br>(Reference paragraph D3.1.5.1.1, D3.2.1.1.1.2.1, D3.2.1.1.1.2.2, D3.2.1.2.2.1.2, D3.2.1.2.2.1.3) |
| NASDA–ESPC–1539 | JEM Operations System Specification<br>(Reference paragraph D3.7.1.3) |
| SSP 50200–08 | Appendix D Operations Data File Standards<br>(Reference paragraph D3.2.1.2.2.2.1) |
| SSP 50200–08 | Appendix E Operations Nomenclature<br>(Reference paragraph D3.2.1.2.2.2.1) |

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(Unless otherwise indicated, copies of U.S. federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111–5094.)

#### D2.1.2 Other Government documents, drawings, and publications.

The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless other wise specified, the exact issue shown applies to this segment specification.

None

**D2.2 Non–Government publications.**

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced here in and the contents of this specification, the contents of this specification shall be considered a superceding requirement.

**D2.3 Order of precedence.**

In the event of a conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

**D2.4 Meet or exceed.**

The following documents have been identified as meeting or exceeding the applicable SSP documents referenced herein:

None

## D3. SYSTEM REQUIREMENTS

### D3.1 System definition.

#### D3.1.1 System description.

The JEM is a facility consisting of a laboratory, logistics modules, robotic manipulator, and ground facilities for the purpose of supporting research and development experiments in a microgravity environment in an earth orbit. The JEM supports permanent human habitation as a segment of the Space Station. The JEM can support both internal and external user payloads and can transfer equipment and user payloads from the laboratory to the vacuum of space without the need of a pressure suited crew member. The JEM system diagram is shown in Figure D–1.

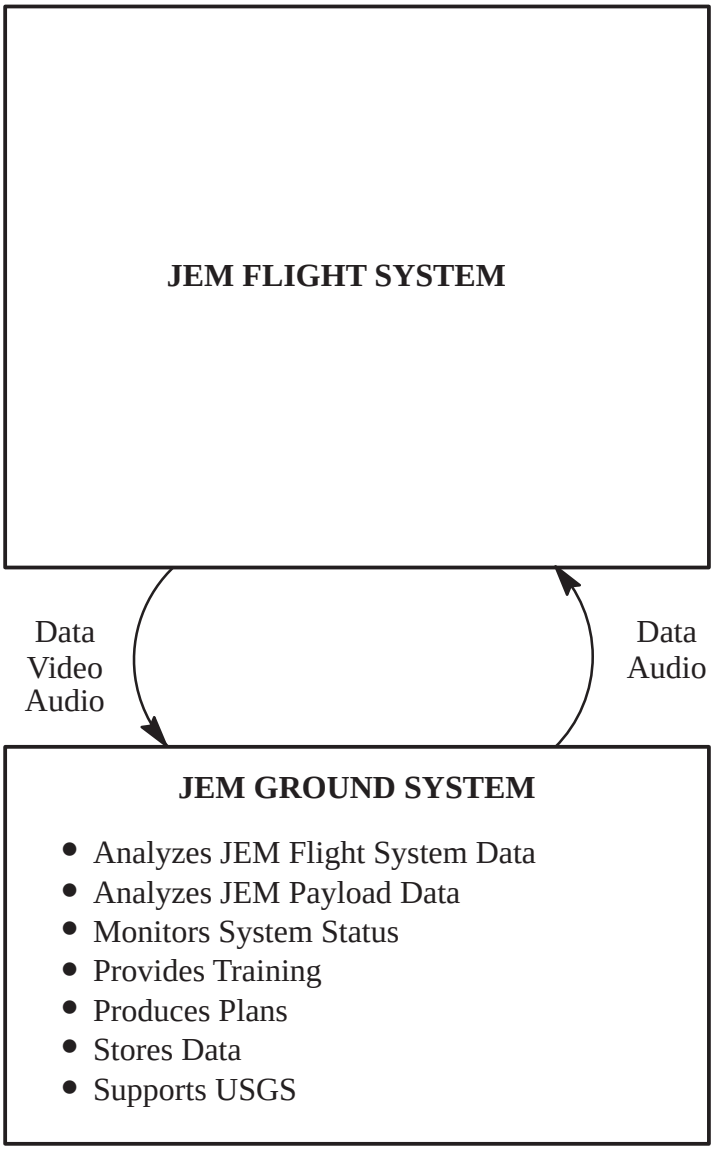


**FIGURE D–1. JEM functional flow and layout**

#### D3.1.1.1 JEM ground system.

The JEM ground system supports JEM operations, Japanese payload operations, Japanese user operations, and JEM system and Japanese payload training.

### D3.1.2 Missions.

### D3.1.3 Threat.

Not applicable.

### D3.1.4 System diagrams.

### D3.1.5 Interface requirements.

#### D3.1.5.1 External interfaces.

The JEM functional external interfaces are as shown in Figure D–2.

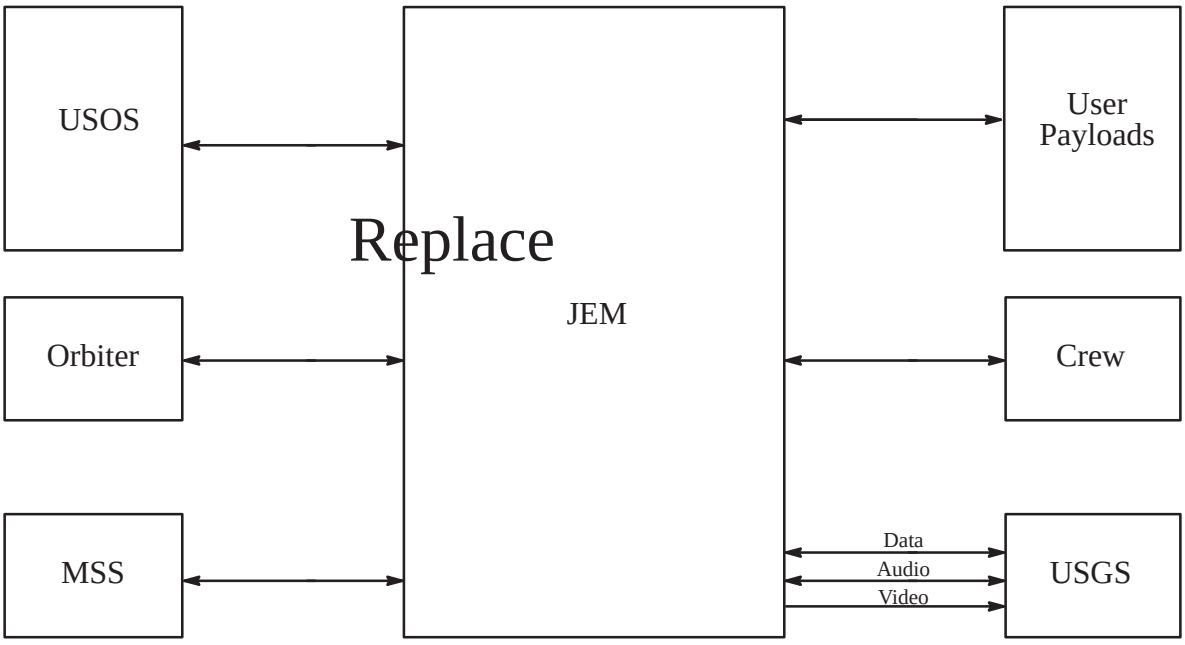


**FIGURE D–2. JEM external interfaces**

#### D3.1.5.1.1 United States Ground System (USGS) external interface descriptions.

The JEM ground facility will interface with USGS to exchange audio and operations data, receive data and video, and send payload commands and files. This interface is defined in accordance with SSP 45012 and SSP 45025.

### D3.1.5.2 Internal interfaces.

The JEM functional internal interfaces are as shown in Figure D–3.

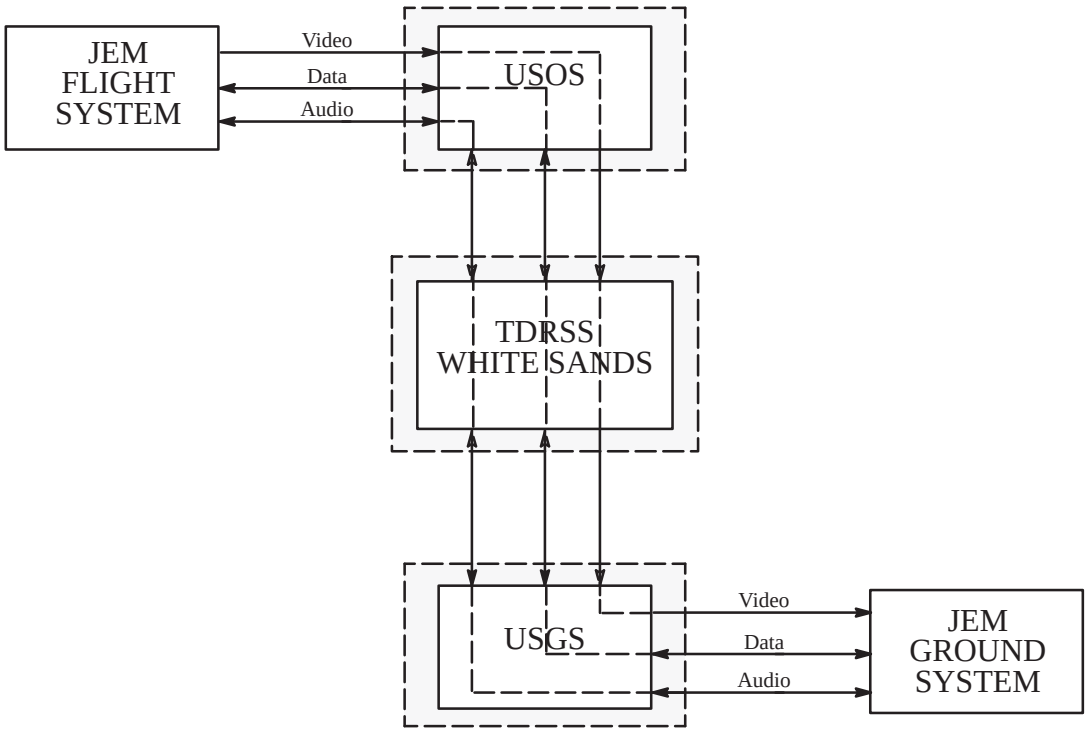


**FIGURE D–3. JEM internal interfaces**

#### D3.1.5.2.1 JEM flight system internal interface descriptions.

The flight system interfaces with the JEM ground system functionally through the USOS, Tracking and Data Relay Satellite Systems (TDRSS), and the USGS. Through this interface the JEM flight system transmits data, video, and audio to and receives data and audio from the JEM ground system.

#### D3.1.5.2.2 JEM ground system internal interface descriptions.

This interface is as described in paragraph 3.1.5.2.1.

**D3.2 Characteristics.**

**D3.2.1 Performance characteristics.**

**D3.2.1.1 State: Perform mission – habitable.**

**D3.2.1.1.1 Mode: Standard habitable.**

**D3.2.1.1.1.1 Capability: Perform ground mission operations.**

**D3.2.1.1.1.1.1 Capability: Space Station system performance analysis.**

The JEM ground system shall provide the capability to analyze on–orbit JEM performance.

The JEM ground system shall provide the capability to support the management of on–orbit JEM configuration, resources, maintenance, and inventory.

**D3.2.1.1.1.1.2 Capability: Support on–orbit operations.**

The JEM ground system shall provide the capability to monitor on–orbit JEM and Japanese payload operations, and assess operations with respect to defined plans.

The JEM ground system shall provide the capability to support the development and execution of planned and alternative on–orbit JEM operations.

The JEM ground system shall provide the capability to coordinate the JEM and user payload command and control operations.

The JEM ground system shall provide the capability to coordinate the JEM and user payload ground operations.

The JEM ground system shall have the capability to access operational and non–operational data.

**D3.2.1.1.1.2 Capability: Support on–orbit ground communications.**

**D3.2.1.1.1.2.1 Capability: Provide data for uplink.**

The JEM ground system shall provide capability to acquire, prepare, and transmit commands via USGS for uplink in accordance with ICD SSP 45012 and ICD SSP 45025.

The audio and system data shall be transmitted to the JEM via the USGS/USOS in accordance with ICD SSP 45012 and ICD SSP 45025.

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The JEM ground system shall comply with security/privacy requirements developed by the Space Station Program Office for transmission of data for uplink.

**D3.2.1.1.1.2.2 Capability: Support down link data.**

The JEM ground system shall provide capability to receive and convert JEM system data and Japanese payload data from the USGS in accordance with ICD SSP 45012 and ICD SSP 45025.

The JEM ground system shall receive video, audio, high rate, and system data from the JEM via the USOS/USGS in accordance with ICD 45012 and ICD SSP 45025.

The JEM ground system shall comply with security/privacy requirements developed by the Space Station Program Office for transmission of downlink data.

**D3.2.1.1.1.2.3 Capability: Provide ground–based payload physical integration.**

**D3.2.1.1.1.2.4 Capability: Provide ground–based interface checkout for payloads.**

The JEM ground system shall provide the capability to perform interface checkout of payloads with on–orbit JEM and ground command and control capabilities.

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**D3.2.1.2 State: Support mission.**

A stable condition of the Space Station which may be concurrent with and independent from the "perform mission" states. This state is characterized by the ground based preparation for and recovery from Space Station increment operations.

**D3.2.1.2.1 Mode: Personnel preparation.**

**D3.2.1.2.1.1 Capability: Prepare and conduct training.**

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The prepare and conduct training mode consists of the functions required to ensure ground personnel and on–orbit crew working knowledge of the systems they will operate and maintain. This mode will begin when crew members start training for the activities associated with a specific increment and ends when an appropriate level of proficiency for these activities has been demonstrated. This mode consists of the capabilities as shown in Table D–I and the following unique capabilities:

TABLE D–I. Mode/capability applicability matrix

| Capability | Mode | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Standard – Habitable | Reboost – Habitable | Maneuver – Habitable | Microgravity – Habitable | Survival – Habitable | Proximity – Habitable | Assured safe crew return | External operations – Habitable | Standard – Untended | Reboost – Untended | Maneuver – Untended | Microgravity – Untended | Survival – Untended | Proximity – Untended | External operations – Untended | Personnel preparation | Operations planning |
| Relieve overpressure | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Equalize pressure | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Control atmosphere temperature | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | | |
| Control atmosphere moisture | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | | |
| Circulate atmosphere | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | | |
| Illuminate internal area | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Control internal lighting | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Illuminate video area–external | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Isolate to recovery level | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Recover lost function | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Isolate for safing | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Safe | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Maintain station mode | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Transition station mode | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Provide data to crew | * | * | * | * | * | * | * | * | | | | | | | | | |
| Accept crew inputs and commands | * | * | * | * | * | * | * | * | | | | | | | | | |
| Acquire function status data | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Assess function status data | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Acquire hazardous condition data | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Identify hazardous conditions | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Respond to fire | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Respond to hazardous atmosphere | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Distribute user payload power | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Perform user payload thermal conditioning | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Supply vacuum services to user payloads | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Distribute gases to user payloads | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Transfer user payload command and control data | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Support user payload telemetry services | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Support user payload video services | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Space station system performance analysis | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Support on–orbit operations | * | * | * | * | | * | * | * | * | * | * | * | | * | * | | |
| Distribute power | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Collect thermal energy | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |

TABLE D–I. Mode/capability applicability matrix – Continued

| Capability | Mode | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Standard – Habitable | Reboost – Habitable | Maneuver – Habitable | Microgravity – Habitable | Survival – Habitable | Proximity – Habitable | Assured safe crew return | External operations – Habitable | Standard – Untended | Reboost – Untended | Maneuver – Untended | Microgravity – Untended | Survival – Untended | Proximity – Untended | External operations – Untended | Personnel preparation | Operations planning |
| Distribute thermal energy | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Distribute time | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Support internal crew restraint and mobility | * | * | * | * | * | * | * | * | * | | | | | | | | |
| Control airborne particulate contaminants | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | | |
| Control airborne microbial growth | * | * | * | * | * | * | * | * | * | * | * | * | | * | * | | |
| Provide direct visual access | * | * | * | * | * | * | * | * | | | | | | | | | |
| Provide remote visual access | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Set up voice communication | * | * | * | * | * | * | * | * | | | | | | | | | |
| Transmit voice communication | * | * | * | * | * | * | * | * | | | | | | | | | |
| Receive voice communication | * | * | * | * | * | * | * | * | | | | | | | | | |
| Generate pointing and support data | | | | | | | | * | | | | | | | | | |
| Support uplinked data | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Provide data for downlink | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Provide data for uplink | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Support downlinked data | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| Support internal equipment removal and replacement | * | * | * | * | * | * | * | * | | | | | | | | | |
| Support internal equipment restraint | * | * | * | * | * | * | * | * | | | | | | | | | |
| Limit accelerations | | | | * | | | | | | | | * | | | | | |
| Perform external robotic operations | | | | | | | | * | | | | | | | | | |
| Perform task training | | | | | | | | | | | | | | | | * | |
| Perform functional training | | | | | | | | | | | | | | | | * | |
| Perform operations training | | | | | | | | | | | | | | | | * | |
| Perform resupply / return planning | | | | | | | | | | | | | | | | | * |
| Develop increment operations planning products | | | | | | | | | | | | | | | | | * |
| Develop weekly planning products | | | | | | | | | | | | | | | | | * |
| Perform realtime planning support | | | | | | | | | | | | | | | | | * |
| Develop preliminary procedures | | | | | | | | | | | | | | | | | * |

**D3.2.1.2.1.1.1 Capability: Perform basic training.**

The JEM ground system shall provide JEM systems and Japanese payload task training.

**D3.2.1.2.1.1.2 Capability: Perform advanced training.**

The JEM ground system shall provide JEM element and Japanese payload functional training.

**D3.2.1.2.1.1.3 Capability: Perform increment specific training.**

The JEM ground system shall support Station increment specific operations training.

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**D3.2.1.2.2 Mode: Operations planning.**

This mode consists of those functions provided by the Space Station system associated with planning, analyses, and procedures to support any specific increment. This mode begins approximately 24 months prior to an increment and ends with the completion of the increment. This mode consists of the capabilities as shown in Table D–I and the following unique capabilities:

**D3.2.1.2.2.1 Capability: Perform increment planning.**

**D3.2.1.2.2.1.1 Capability: Perform resupply/return planning.**

The JEM ground system shall provide the capability to support the development of resupply/return plans for the on–orbit JEM, Japanese payloads, and Japanese flight crew cargo items needed for increment operations.

**D3.2.1.2.2.1.2 Capability: Develop increment operations planning products.**

The JEM ground system shall provide the capability to develop, maintain, and transmit to the USGS the data required for preincrement planning in accordance with ICD SSP 45012 and ICD SSP 45025.

**D3.2.1.2.2.1.3 Capability: Develop weekly planning products.**

The JEM ground system shall support the development of the integrated JEM element Short Term Plan (STP) in accordance with ICD SSP 45012 and ICD SSP 45025.

The JEM ground system shall provide the capability to export planning data to the USGS for inclusion in the Station Short Term Plan (STP) in accordance with ICD SSP 45012 and SSP 45025.

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**D3.2.1.2.2.1.4 Capability: Perform real–time planning support.**

The JEM ground system shall provide the capability to support the USGS real–time planning and replanning.

**D3.2.1.2.2.2 Capability: Develop and maintain procedures.**

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**D3.2.1.2.2.2.1 Capability: Develop preliminary procedures.**

The JEM ground system shall provide the capability to develop JEM operations procedures.

Operations procedures and reference information shall be developed in accordance with SSP 50200–08 Appendix D Operations Data File Standards and SSP 50200–08 Appendix E Operations Nomenclature.

**D3.2.1.2.2.2.2 Capability: Maintain final procedures.**

The JEM ground system shall provide the capability to store JEM operations procedures.

The JEM ground system shall provide the capability to maintain JEM operations procedures.

**D3.2.1.2.2.2.3 Capability: Deliver final procedures.**

The JEM ground system shall provide the capability to produce final JEM operations procedures.

The JEM ground system shall provide the capability to deliver final JEM operations procedures.

**D3.2.1.2.3 Mode: Reconfiguration preparation.**

**D3.2.1.2.3.1 Capability: Integrate reconfiguration products.**

**D3.2.1.2.3.1.1 Capability: Provide reconfiguration products and data files.**

The JEM ground system shall support the build and management of JEM reconfiguration products and data.

**D3.2.1.2.3.1.2 Capability: Verify reconfiguration products.**

The JEM ground system shall verify JEM reconfiguration products.

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### D3.3 Design and construction.

#### D3.3.1 Workmanship.

Not applicable

#### D3.3.2 Interchangeability.

#### D3.3.3 Safety.

##### D3.3.3.1 Hazardous commands.

All ground and on–board crew initiated commands involving safety critical functions shall be two–step operations, with positive feedback to the initiator reporting the impending results of the command, prior to acceptance of the execute command.

### D3.4 Computer resource requirements.

### D3.5 Logistics.

### D3.6 Personnel and training.

### D3.7 Characteristics of major functional elements.

#### D3.7.1 JEM ground system.

##### D3.7.1.1 Purpose.

The purpose of the JEM ground system is to support the JEM flight system, Japanese payloads, and Japanese users both before and during on–orbit operations.

##### D3.7.1.2 Description.

The JEM ground system facilities are located in the Japanese Space Station Integration and Promotion Center (SSIPC) and comprises the computers, simulators, and other equipment to perform JEM engineering assessments, payload operations and user support, Japanese payload integration, logistics operations, and crew training for JEM system and Japanese payload operations.

### D3.7.1.3 Capabilities.

The capabilities of the JEM ground system are described in accordance with NASDA–ESPC–1539, Operations System Specification.

## D3.8 Precedence.

All specifications, standards, exhibits, drawings or other documents that are referenced in this specification are hereby incorporated as cited. All documents that are referred to by a reference document are considered to be for guidance and information only, with the exception of ICDs and Interface Requirements Documents (IRDs), which shall have their reference documents considered to be incorporated as cited. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. This document also takes precedence over the Space Station system specification. Nothing in this document, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

## D4. QUALITY ASSURANCE PROVISIONS

### D4.1 General.

JEM segment level qualification will be conducted by inspection, analysis, demonstration, or test. Test is chosen as the verification method to verify performance requirements that are not readily observable.

These methods are defined as follows:

a. Inspection. Engineering, inspection, hereafter referred to as inspection, is a method of verification that determines conformance to requirements by the use of standard quality control methods to ensure compliance by review of drawings and data. This method is used wherever documents or data can be visually used to verify the physical characteristics of the product instead of of the performance of the product.

b. Analysis. Analysis is a process used in lieu of, or in addition to, other methods to ensure compliance to specification requirements. The selected techniques may include, but not be limited to, engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analysis may be used when it can be determined that (1) rigorous and accurate analysis is possible, (2) test is not cost effective, and (3) verification by inspection is not adequate.

c. Verification by similarity is the process of analyzing the specification criteria for hardware configuration and application for an article to determine if it is similar or identical in design, manufacturing process, and quality control to an existing article that has previously been qualified to equivalent or more stringent specification criteria. Special effort will be made to avoid duplication of previous tests from this or similar programs. If the previous application is considered to be similar, but not equal to or greater in severity, additional qualification tests shall concentrate on the areas of new or increased requirements.

d. Demonstration. Demonstration consists of a qualitative determination of the properties of a test article. This qualitative determination is made through observation, with or without special test equipment or instrumentation, which verifies characteristics such as human engineering features, services, access features, and transportability. Demonstration requirements are normally implemented within a test plan, operations plan, or test procedure.

e. Test. Test is a method in which technical means, such as the use of special equipment, instrumentation, simulation techniques, and the application of established principles and procedures, are used for the evaluation of components, subsystems, and systems to determine compliance with requirements. Test shall be selected as the primary method when analytical techniques do not produce adequate results; failure modes exist which could compromise personnel safety, adversely affect flight systems or payload operation, or result in a loss of mission objectives; or for any components directly associated with Space Station and orbiter interfaces. The analysis of data derived from tests is an integral part of the test program, and should not be confused with analysis as defined above. Tests shall be used to determine quantitative compliance to requirements and produce quantitative results.

### D4.1.1 Responsibility for verifications.

NASDA is responsible for verifying the JEM fulfills the performance and constraint requirements set forth within this specification.

### D4.1.2 Special tests and examinations.

Not applicable.

### D4.2 Segment quality conformance inspections.

### D4.2.1 Requirement/verification cross reference matrix.

Not applicable.

## D5. PREPARATION FOR DELIVERY.

NA.